JOINT MANAGEMENT PLAN REVIEW
DRAFT ACTION PLAN: Ecosystem Protection – Krill Harvesting

REVISED: 5/1/03

Please Note: The Sanctuary Advisory Council and MBNMS have tasked the management plan working groups with development of draft action plans that characterize the issue or problem and identify strategies and activities that address the issue. The working groups will develop these strategies and activities as they meet over the next several months. With this goal in mind, the progress of the group, the decisions, areas of agreement will be outlined in a progressively developed action plan identifying draft goals, issue characterizations, and strategies and activities. Members of the group as well as other interested parties should look to this draft action plan as it develops as a way of tracking the group's progress and decisions.

GOAL:

To protect the marine ecosystem of the Monterey Bay National Marine Sanctuary by identifying and pursuing a strategy that will lead to a permanent ban on krill harvesting within Sanctuary waters.

BACKGROUND:

The Sanctuary is mandated to approach resource protection from a broad, ecosystem based perspective and has been funding research regarding the role that krill play in the region's marine ecosystem. Krill are a critical component of the marine ecosystem and fundamental to the trophic structure of the marine life within the Sanctuary. The two principal species of krill that exist within the MBNMS and throughout the California current are *Euphausia pacifica* and *Thysanoessa spinifera.* These species are preyed upon by almost all commercially important species within Sanctuary waters including salmon, rockfish, squid, sardine, mackerel and flatfish. Blue whales, humpbacks, and numerous seabirds including sooty shearwaters, marbled murrelets, and common murres are dependent on krill as forage. Reliable regional estimates of biomass and prey requirements do not exist. However, it has been estimated that krill makes up between 15 and 60 percent of the diet of commercially significant fish in ecosystems with comparable trophic structures.[1]

Krill are currently not harvested within the Sanctuary, however the potential exists for this fishery to develop in the future due to an increasing need for aquaculture feed. A krill fishery could not only severely impact the integrity of the marine ecosystem but could adversely affect commercial and recreational fisheries of all kinds as most target species are directly or indirectly dependent on the resource. To address this issue, MBNMS will explore the potential for the

future harvest of krill, outline the current regulatory framework, and recommend permanent restrictions in the Sanctuary.

Current State and Federal Management

In 2000, California became the first state to ban fishing for krill in state waters. The bill was introduced by Assemblywoman Virginia Strom-Martin, and was aimed at "protecting the marine food web by stopping any krill fishery before it could be started in the state." The Strom-Martin bill was requested by the Pacific Coast Federation of Fishermen's Associations (PCFFA) and conservation groups after a krill fishery was established off British Columbia (BC). A commercial harvest of krill off the Canadian east coast has been implicated in the poor recovery of cod in the region; the BC krill fishery is the first off the Pacific coast. PCFFA and others were concerned that "fishing for this essential link in the food chain would prevent the recovery of highly valuable and threatened commercial fish." This bill prohibits the taking of krill of the genus *Thysanoessa* or the genus *Euphausia* for commercial purposes from state waters or the landing of krill at any state port until January 1, 2011. The bill would further provide that after January 1, 2011, this commercial taking or landing is prohibited unless permitted under regulations adopted by the commission. There has been no federal action considered prohibiting or limiting krill fishing in federal waters by the regional councils, the National Marine Fisheries Service (NMFS), or Congress.

Description of Potential Fishery in MBNMS

The largest current market for krill on the west coast exists in Oregon and Washington where salmon farms use krill meat to give farm raised fish their pinkish color. Most of the supply comes from the British Columbia fishery, however the uniquely productive waters of the Sanctuary hold dense concentrations of krill and would likely be exploited if a fishery were to begin in U.S. waters. In addition, NMFS is currently soliciting comments on their proposed Code of Conduct for Offshore Aquaculture, which could place net pens in areas of the Sanctuary. This code was generated pursuant to the Department of Commerce's stated goal of a five hundred percent increase in the nation's aquaculture by the year 2025. Operators of these net pens will likely demand krill or other prey species as feed stock for the raised fish. This may further increase the likelihood of a krill fishery developing within Sanctuary waters.

A krill fishery within the MBNMS would likely correspond to peak krill abundance and aggregation which occurs in summer and early fall. Any of the trawling vessels at the ports associated with the Sanctuary could participate, and as other fisheries are closed down there will be an increasing number of vessels searching for viable alternatives. However, there are several key limitations that may serve to effectively exclude most local fishermen from any emerging krill fishery. Perhaps most significantly the Strom-Martin bill not only prohibits the taking of krill from state waters but it also makes landing krill in any state port illegal. Therefore, a krill fishery on the central coast could consist of large factory trawlers or smaller vessels dumping

catches into aquaculture facilities. The factory trawlers operating in the Southern Ocean have harvested krill at a rate as high as thirty five tons of krill in eight minutes.

A krill fishery may have serious adverse impacts on many of the local commercially important fish stocks including salmon, rockfish, sardine and squid as these species are heavily dependent on krill as a food source. The aquaculture facilities would also compete directly with the wild caught fisheries within the Sanctuary. Prohibiting this fishery now would preclude a post-hoc redistribution of effort and prevent later socio-economic impact.

The Antarctic Example

While the overall take of Antarctic krill is relatively low compared to its abundance, concerns have been raised over fishing's regional effects. The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) has instituted an ecosystem monitoring program to detect and record significant changes in critical components of the ecosystem. It has been assumed that it is possible to assess the effects of fishing on krill availability through some index of predator performance. Predator data has therefore been incorporated into the management scheme. Accordingly, a system to regularly record selected life history parameters of key seabird and seal populations has been in place since 1986. Despite calculations of krill yield that take into account krill and predator requirements, CCAMLR has been aware of the potential for local competition between predators and the krill fishery. On a global or regional scale fishing mortality might remain within the limits set by management and so provide sufficient escapement for predator needs. However, on a local level mortality may be much greater and escapement too low to support predators with restricted foraging ranges, or may cause a shift in the behavior and distribution of more widely ranging species. This concern is exacerbated by the timing of the krill fishery during months where many species of breeding bird and seal predators are dependent on the resource.

It has been reported that in South Georgia, in the Southern Ocean, seals, penguins and albatrosses are having difficulty in rearing offspring successfully as demand for krill has begun to exceed supply in some areas. Twenty years of long-term monitoring of seabirds and seals on South Georgia has revealed an increase in the frequency of years when there is insufficient krill to feed seal pups and seabird chicks. The animals did well in the 1980s while stocks of krill were abundant but demand began to exceed local supply in the 1990s. The extent to which these changes result from a decrease in the amount of krill or an increase in predator demand is uncertain. However, the similarity between the supply and demand is a new discovery and throws into question the apparent super-abundance of krill over all of the Southern Ocean. Seals and seabirds now consume such a large proportion of the krill population at South Georgia that they amplify the effects of gradual, underlying environmental changes. The discovery provides a new insight into the status of krill at South Georgia and highlights a vital need to re-examine the scales at which krill stocks are managed through CCAMLR.

DRAFT

Issues of Concern for MBNMS

The oceanographic and bathymetric features of the MBNMS makes it susceptible to the adverse effects of krill fishing. The Monterey submarine canyon, and portions of the Carmel Canyon provide krill with a distinctive habitat that contributes to their abundance and degree of aggregation.[2] This makes the waters within the Sanctuary a critical feeding ground for countless forms of wildlife. These include predators like the blue whale, dense concentrations of seabirds, and commercially important fish species such as salmon and rockfish. The canyon habitat provides opportunity for high nighttime surface feeding due to its location downstream from an upwelling center, a refuge from daytime predation as krill can migrate to depths in excess of 100m in the canyon, and reduced swimming energy output during daytime schooling at depth due to reduced canyon slope currents. The Sanctuary also contains several productive upwelling centers that generate high levels of primary production leading to dense aggregations of krill.[3]

Thus the Sanctuary's concerns about a krill fishery can be summarized as follows.

- Wildlife viewing in general and whale watching in particular are critical components of the local tourism industry. A krill fishery would coincide with the times of peak whale abundance, competing with the whales for forage and with species of seabird that are seasonally reliant on the resource.
- Bycatch is also a concern in that even though krill swarms are densely aggregated, a very fine mesh net is used which would indiscriminately catch larger predators.
- A krill fishery could adversely impact commercial and recreational fisheries of all kinds as all target species are directly or indirectly dependent on the resource. In fact, seven out of ten of the most commercially significant stocks in the region are dependent on krill as forage. (Market squid diet composition consists of almost 97% krill[4] and Pacific Hake 98% krill[5])
- In addition, many rebuilding groundfish stocks are reliant on the resource. (Boccacio diet composition consists of 21-50%[6] krill, widow rockfish 21-50%[7], and yellowtail rockfish over 50%[8])

Statutory and Regulatory Context for Prohibiting Krill Harvesting

The National Marine Sanctuary Act focuses on protection of the ecosystem as a whole, a field in which the Sanctuary Program has 30 years experience. The National Marine Sanctuary Program and the Monterey Bay National Marine Sanctuary recognize that the primary regulatory authority over fisheries management resides with NMFS and PFMC, and as an initial step on any fishing related matter will encourage these agencies to take the necessary measures. The original Designation Document and Final EIS for the MBNMS state that existing fisheries are not being regulated as part of the initial MBNMS regulatory regime. However, the Final EIS also states that if MBNMS regulatory exemptions for fishing threatens Sanctuary resources, NOAA could undertake rule changes consistent with Federal procedures. If it is determined that additional

ecosystem protection regulations that impact fishing need to be implemented, the Sanctuary would consult with the Pacific Fishery Management Council (PFMC), NMFS, the California Department of Fish and Game (if applicable), affected fishermen and related parties, and the public. When appropriate, the Sanctuary may request that the relevant fishery management agency address MBNMS concerns within that agency's own statutory and regulatory context. In situations where the legal framework of that agency preclude it from adequately addressing Sanctuary objectives, then pursuant to subsection 304(a)(5) of the NMSA, the Council would be given the opportunity to prepare draft Sanctuary fishing regulations for the portion of the Sanctuary within federal waters. Pursuing the restriction of krill harvesting is therefore a legitimate means for the Sanctuary to both meet its mandate, and a valuable opportunity to provide its ecosystem based perspective to fisheries management.

PLAN COMPONENTS:

This working group will identify and pursue strategies that result in a permanent ban on harvesting krill anywhere within the Sanctuary. The strategies will be slightly different for state and federal waters. In the federal context, the initial phase will focus on communicating with fishery management agencies and identifying issues and concerns that both the Sanctuary and the agencies have. The Sanctuary will concurrently create an ecological report that includes an overview of the importance of krill to the marine ecosystem within the MBNMS and an assessment of the potential ecological and economic impacts of a krill fishery . The next phase would involve approaching NMFS, PFMC and the state legislature with this information, with the objective of having these entities enact a permanent ban on krill harvesting. With the cooperation of these agencies the necessary NEPA analysis would be performed and the regulation will be promulgated and enforced. In the state context, the Sanctuary would identify partners interested in lobbying state legislators to make the current temporary state prohibition a permanent one.

DRAFT

Citations:

[1] Nicol, S. & Endo, Y. Krill Fisheries: Development, Management and Ecosystem Implications. Aquat. Living Resour. 12 (2) (1999) 105-120.

[2] Croll, D.A., B. Marinovic, S. Benson, F.P. Chavez, N. Black, R. Temullo, B.R. Tershy. 2000. From Wind to Whales: Trophic Links in a Coastal Upwelling System. Final Report to the Monterey Bay National Marine Sanctuary, Contract No. 50ABNF500153

[3] Benson, S.R., D. A. Croll, and B. Marinovic. Whales, krill, and variability of two coastal upwelling centers. Tech. Report No. 01-1. 2001

[4] Karpov, K.A., Pand G.M. Cailliet. 1979. Prey composition of the market squid, *Loligo opalescens* in relation to depth and location of capture, size of squid, and sex of spawning squid. CalCOFI Rep. 20: 51-57.

[5] Livingston, P.A. 1983. Food habits of Pacific whiting, Merluccius productus, off the west coast of North America, 1967 and 1980. Fish. Bull., U.S. 81:629-636. *Note: Seasonal study conducted in Fall. Other studies have found a reduced reliance on krill in other seasons*

[6] Reilly, C.A., 1992. Interannual variation and overlap in the diets of pelagic juvenile rockfish (Genus: Sebastes) off

central California.. Fish. Bull. 90(3):505-515.

[7] Dark, T.A., M.E. Wilkins, and K. Edwards. 1983. Bottom trawl survey of canary rockfish (Sebastes pinniger), yellowtail rockfish (S.flavidus), bocaccio (S. paucispinis), and chilipepper (S. goodei) off Washington-California, 1980. U.S. NOAA/NMFS Tech. Memo. 48. 40p.

[8] Pereyra, W.T., W.G. Pearcy and F.E. Carvey Jr., 1969. Sebastodes flavidus, a shelf rockfish feeding on mesopelagic fauna, with consideration on the ecological implications.. J. Fish. Res. Board Can. 26(8): 2211-2215.

DRAFT

STRATEGY MB-KH1 - ENGAGE FEDERAL FISHERIES MANAGEMENT AGENCIES

This strategy seeks to engage the Pacific Fisheries Management Council (Council) and the National Marine Fisheries Service (NMFS) in a preliminary discussion regarding the issue of krill harvesting and to establish a protocol for future interactions. It would include identifying concerns that they might have, how they might address the issue, and what type of information they would require. Involving the federal fishery management agencies at an early stage of the process will apprise them of the Sanctuary's concerns regarding krill harvesting and will serve to ensure that the Sanctuary is proceeding in a way that coincides with the needs and concerns of these agencies.

Activities designated for this strategy:

Activity A: Initiating contact with the federal management agencies
Staff and working group members will approach staff from the NMFS regulatory branch, Council staff, and Council members to discuss what thoughts and concerns these entities have regarding the issue and how best to proceed with initiating a ban on krill harvesting. This activity will include a preliminary presentation to the Council.

Project status: Ongoing
Partners: NMFS, PFMC

DRAFT

Activity B: Document the statutory, regulatory, ecological, and economic rationale for seeking a cooperative action to prohibit krill harvesting.
With input from working group members, the Sanctuary will create a document that describes the role krill play in the trophic structure of the marine ecosystem. The document will also describe the characteristics, potential impacts, and reasons for prohibiting a krill fishery within the Monterey Bay National Marine Sanctuary.

Project Status: Ongoing
Partners: World Wildlife Fund, Save Our Shores, NMFS, UCSC, Point Reyes Bird Observatory

Activity C: Make a formal presentation of the Sanctuary's request and supporting documentation at the June Council meeting in San Mateo.
At the June Council meeting, the Sanctuary will formally present its request that the Council

recommend to NMFS that it agree to draft regulations that prohibit krill harvesting within the Sanctuary.

Project Status: Completed by June 21, 2003
Partners: NMFS

DRAFT

STRATEGY MB-KH2- ASSIST THE COUNCIL AND NMFS IN CREATING AND IMPLEMENTING KRILL HARVESTING REGULATION

This strategy will be pursued after the Council and NMFS have had an opportunity to identify their position on this issue. The timeframe associated with these activities assume that the Council will make a decision at the June 2003 meeting. The respective roles of the Sanctuary, NMFS, and the Council will to some extent be determined by the inclination and ability of the fishery management agencies to allocate staff time to the issue. The activities associated with this strategy account for this variable.

Activity A: Draft Regulatory Proposal

The degree of action that NMFS and the Council agree to take on the issue of krill harvesting and the amount of staff time they are willing to allocate will influence the role that the Sanctuary will play in this regard. The Council and NMFS will be given the opportunity to draft the regulations themselves, however, they may request that the Sanctuary assist in this capacity. Regardless of which entity drafts the regulatory language, the Sanctuary will be responsible for fulfilling the NEPA requirements. This will involve considering a range of alternatives including a no-action alternative. The Sanctuary will also hold a notice and comment period and provide opportunity for a hearing as required by the Administrative Procedure Act. Once this activity is completed, NMFS will publish the regulation in the federal register and the prohibition will be enforceable.

DRAFT

Project Status: Completed October 2003
Partners: NMFS, PFMC,

Activity B: Draft Enforcement Program

Sanctuary enforcement personnel will work with the U.S. Coast Guard and the Department of Fish and Game to enforce the prohibition and prosecute violations. This activity will involve educating other deputized enforcement agencies.

Project Status: Ongoing after promulgation
Partners: NMFS, CDFG, USCG, NOAA General Counsel

STRATEGY MB-KH3- PURSUE A PERMANENT BAN ON KRILL HARVESTING WITHIN STATE WATERS

There is currently a ban on harvesting within state waters or landing krill at a state port. This prohibition sunsets in 2011 at which time krill harvesting will be by permission of the Fish and Game Commission. This strategy will be to partner with other agencies and organizations to explore making the prohibition a permanent one.

Activity A: Explore permanent ban within state waters.
The Sanctuary will identify other agencies, non-profits, and other institutions that may be interested in making the ban on krill harvesting within state waters permanent. This campaign may be accompanied by an educational effort to create public awareness and support for the legislative action.

Project status: Ongoing
Potential partners: Department of Fish and Game, Fish and Game Commission, PCFFA, Save Our Shores, The Ocean Conservancy, Point Reyes Bird Observatory, Oceana, , The Alliance of Communities for Sustainable Fisheries, Blue Water Network, , researchers, NMFS, PFMC

DRAFT